Fact Sheet #7: Functions of Riparian Areas for the Protection of Land Containing Shellfish

---

[This fact sheet was prepared by Russell Cohen, Rivers Advocate, Riverways Program, Massachusetts Department of Fish and Game, and Jan Smith, Coastal Nonpoint Program Coordinator, Massachusetts Office of Coastal Zone Management. This document is intended for educational purposes only and does not necessarily represent the viewpoint of agencies and commissions having regulatory authority over riparian lands. Date: June 4, 1997.]

What is the relationship between riparian areas and land containing shellfish?

Habitat: Riparian areas (rivers, streams and adjacent lands) perform a number of beneficial functions for land containing shellfish. The most obvious function is that of habitat. For example, extensive beds of steamers and other clam species are found in mudflats along the sides and bottom of many tidal estuaries and creeks. Oysters tend to be even more directly connected to tidal rivers and other waterbodies where freshwater inputs result in reduced salinity levels. The reason for this habitat preference is that oysters can tolerate less salty water while one of their major predators, the whelks, cannot. Shellfish are by no means confined to salty habitat, however. Massachusetts is home to many species of freshwater mussels, an important component of stream biota (more about these below).

Vital Ecosystem Link: Naturally vegetated riparian areas along rivers and streams are an important component of a larger ecosystem that supports healthy coastal and freshwater shellfish populations. Clams, oysters, mussels and other (relatively) stationary mollusks are filter feeders. As such, they depend on a healthy supply of microorganisms which in turn receive a significant proportion of their sustenance from nutrients contributed by rivers and streams. Organic detritus such as decaying leaves, twigs and other residue from streamside vegetation falling into the water fuels the base of the aquatic food chain. Filter feeders, such as shellfish, are located near the bottom of this chain and so are particularly influenced by the quantity and quality of the nutrients contributed to the ecosystem by riparian areas.

Sensitivity to Pollutants: This filter-feeding characteristic makes shellfish particularly susceptible to water-borne pollutants. These pollutants fall into two major categories: a) pollutants that are directly toxic to shellfish; and b) pollutants of a type and/or concentration that may be tolerable by the shellfish themselves but yet render them unfit for human consumption. In either case, naturally vegetated riparian areas along rivers and streams act as living filters to intercept and absorb excess nutrients, pathogens, and other pollutants carried along in runoff from adjacent development as well as by the river itself. This is accomplished by several biochemical processes, including the uptake of excess nutrients and heavy metals into living plant tissues and the breakdown of these and other pollutants into less harmful substances by beneficial soil bacteria. In the meantime, streamside forests contribute large woody debris (tree trunks and roots, e.g.) extending into the water, which provide ample surface area to support a large population of microbes that consume excess nutrients and other pollutants already in the water.

Why are coastal shellfish resources particularly sensitive from a water quality standpoint?

Human Health Risks: While low levels of contaminants may not always directly harm coastal shellfish, if pollutants such as fecal coliform bacteria and other pathogens are found in the water above a certain concentration, the shellfish become a health risk for human consumption. Public health standards are very strict to protect human health, so that even low levels and potential threats from bacterial sources can cause the closure of shellfish harvesting areas. Higher levels of these and/or other contaminants may harm shellfish reproduction or cause shellfish to sicken and die.

Economic Impacts: The economic impacts of shellfish closures are significant and immediate when shellfish beds are closed due to pollution. Often the closures are temporary and occur right after a rainstorm since it has been well documented that stormwater runoff from previously developed riparian and coastal areas frequently carries high levels of bacteria. Other closures are of a long-lasting nature when the pollutant source, such as failing or improperly sited septic systems located within a riparian area, is a permanent contributor of bacteria.

Why are riparian areas along inland rivers and streams important to the health of coastal shellfish populations?

Inland rivers empty into estuaries and other coastal areas. Although the biggest threats to coastal shellfish populations come from pollutant sources close by, pollutants originating many miles inland can also be a problem. Many inland streams are tributaries that feed into larger rivers that themselves discharge into estuaries and coastal areas that are important for recreational and/or commercial shellfish harvesting. Watersheds covering the entire eastern third of the state drain into coastal areas supporting shellfish populations. For example, waters flowing through Monoosnoc Brook in Leominster will eventually join the Nashua River which flows into the Merrimack which eventually flows into a coastal estuary and thence into the Atlantic Ocean just north of Plum Island. Pollution getting into riparian areas adjacent to Monoosnoc Book can be carried many miles downstream to adversely impact shellfish beds at the mouth of the Merrimack River and even beyond into Massachusetts Bay if transported further by ocean currents.

Even if water carried by river systems in the central and western areas of the state don't end up in Massachusetts' territorial coastal waters, polluting activities on riparian lands are likely to be carried downstream where they pose a potential threat to the integrity of coastal shellfish populations elsewhere (the shellfish beds in the Connecticut River estuary and Long Island Sound, for example). Although bacteria and nutrients are sometimes mitigated naturally during the length of a river's flow, this is not always the case, nor is it predictable. Other pollutants such as metals, hydrocarbons, and organic chemicals found in stormwater running off developed riparian areas can actually accumulate in the flow as it moves downstream and to the coast.

What are the ecological and other functions, values and sensitivities of freshwater shellfish species?

Water cleaning and potential commercial value: Freshwater mussels, as filter-feeding organisms, in their quest for food filter out suspended solids and other impurities from the river water, helping to clean the flow. In healthy river systems, dense beds of mussels cover the streambottom, clarifying the water. In addition, many freshwater mussel species have had a long history (in the Midwest at least) of commercial value as sources of freshwater pearls, shell as raw material for buttons, etc., and may be desirable for this purpose again in the future.

Sensitivity to pollution and dependence on fisheries: Many of Massachusetts' native species of freshwater mussels are quite sensitive to pollution and other habitat alteration. Some, such as the dwarf wedge mussel, have become rare as a result. The health of mussel populations is also tied directly to the health of fisheries. Most species of freshwater mussels go through a "glochid" larval stage when they attach themselves to fish fins or gills, ride around for awhile, and then drop off once they've metamorphosed into adults. In this way mussels can move up- and downstream to colonize new habitats throughout a watershed. Healthy shellfish populations may depend on healthy fish populations during this critical early stage in their life cycle. In fact, certain mussel species have evolved a dependence on specific host fish species, so the elimination of the fish from all or a portion of its original range may spell doom for its dependent mussel species as well.

What alterations to riparian areas impair their ability to provide protection to shellfish-growing areas?

Stormwater discharges: Alterations to riparian areas may result in direct discharges of stormwater to rivers and can lead to increased pollutant loadings. These pollutants include bacteria, sediment from erosion, and other contaminants from roadways and adjacent land uses. Vegetated streamside buffers and other stormwater treatment systems act to remove harmful bacteria by slowing down the flow of stormwater and allowing particles, which often carry bacteria, to settle out. If the protective vegetated buffer is removed or reduced to an inoperative width and replaced with development, treatment is frequently ineffective and direct discharges of stormwater will subsequently carry high levels of bacteria from pet wastes on city streets, from poorly managed farm activities, and from other sources directly into rivers. Examples in Massachusetts of where this is already occurring can be found along the Ipswich, Parker, and Taunton Rivers.

Septic system leachate: If sited too close to rivers, septic systems, even when appearing to function properly, can leach pathogens into the surrounding groundwater, which may eventually emerge into rivers and estuaries, carrying the harmful bacteria along with it to contaminate shellfish beds. Without vegetated streamside buffers or equivalent structural or nonstructural treatment systems, excess nutrients in stormwater runoff and septic system leachate can be carried by coastal rivers to shellfish beds where, in certain circumstances, they have been found to prolong the life of harmful bacteria. Nutrients (such as nitrates and phosphates) can also contribute to excessive algal growth in estuaries and disrupt biological processes. Algae can greatly reduce oxygen and light levels and can harm other vegetation such as eelgrass which provides important habitat for scallops and other shellfish.

Excessive sediment: Too much sediment from stormwater can also smother shellfish beds. While shellfish have some capability to withstand sediment movement, continued excessive flow of sediments down a river may change elevations and alter the suitability of a location to support shellfish populations.

What are some best management practices (BMPs) for riparian areas to maintain and enhance their shellfish protection function?

Maintain/restore natural streamside vegetation: The best way to maximize a riparian area's beneficial impact on land containing shellfish nearby and/or downstream is to maintain it in and/or restore it to a naturally vegetated condition. Generally speaking, the further a septic system and other potentially pollutant-generating activities are sited away from a river, the less likely pollutants will leach into the river. The wider the vegetative buffer between such activities and the adjacent river, the greater opportunity for riparian vegetation to intercept and filter the pollution before it gets into the river.

Relocate and/or retrofit pollutant-generating land uses: Current activities within riparian areas that contribute pollution to shellfish beds should either be removed and replaced with natural vegetation, or if that isn't feasible, be retrofitted with structural and/or nonstructural mechanisms that effectively remove pollutants before they get into the adjacent water. Recommended pretreatment technologies to trap sediments and other pollutants include water quality inlets, sediment traps, drainage channels, and deep sump catch basins. Pretreatment is required for use with infiltration technologies (used to infiltrate stormwater back into the ground) and recommended for all others.

Filter systems: Sand filters, organic filters, and constructed wetlands have all demonstrated good pathogen removal performance. Pretreatment is recommended (but not required) for these technologies. Infiltration trenches and infiltration basins are also recommended, but these require pretreatment (e.g., they must be used in combination with one or more of the above techniques). Other vegetated treatment systems such as detention basins, wet ponds, and water quality swales may be used but are not strongly recommended since performance is sometimes poor. Careful design may change this recommendation while additional performance data becomes available.

Source reduction: Source control in the form of pollution prevention is often the lowest cost technology. Snow management is included in this category, since dirty snow removed from roadways and parking lots is often spiked with accumulated pollutants that may be harmful to shellfish and other sensitive aquatic organisms. Plowed snow should never be dumped directly into rivers or placed where it can melt and directly affect riparian areas. DEP issued a policy for snow and ice management in late fall of 1996.

Protect potential shellfish beds: Last but not least, it should be remembered that there is a need to protect not only existing shellfish beds but shellfish growing areas that have the potential to support shellfish populations, even though they may not always be present. Shellfish beds often move for reasons that are not entirely understood, so that the absence of shellfish from a site in a given year may not automatically mean that it is not an important shellfish growing area.